

## **IN THE CLAIMS**

Please amend Claims 15 to 17, 20, 26, and 27 to 31 and add Claims 32 through 35 as indicated below. The current status of all claims in the subject patent application is provided below.

**1. (original) A node comprising:**

a series connection of elements  $E_i$ ,  $i=1,2, \dots N$ , where  $N$  is greater than 1, forming a first optical path, where each of said elements  $E_i$  injects an optical signal of band  $\omega_i$ , and where  $\omega_i$  is disjoint from  $\omega_j$  for all  $i \neq j$ ;

a series connection of elements  $F_i$ ,  $i=1,2, \dots N$ , forming a second optical path, where each of said elements  $F_i$  extracts an optical signal of band  $\omega_i$ ;

a plurality of transmitters  $T_i$ ,  $i=1,2, \dots N$ , coupled to said elements  $E_i$  on a one to one basis; and

a plurality of a receivers  $R_i$ ,  $i=1,2, \dots N$ , coupled to said elements  $F_i$  on a one to one basis.

**2. (original) The node of claim 1 where said first optical path and said second optical path are physically separate paths.**

**3. (original) The node of claim 1 where each of said bands,  $\omega_i$ , is a narrow band that carries a single channel of communication.**

**4. (original) The node of claim 1 where each of said bands,  $\omega_i$ , is substantially a single wavelength.**

5. (original) The node of claim 1 where at least one of said elements  $E_k$ , that injects band  $\omega_k$ , carries a plurality of independent channels of communication.

6. (original) The node of claim 1 where each of said bands,  $\omega_i$ , comprises a plurality of narrow bands centered about wavelengths  $\lambda_j$ ,  $j=1, 2, \dots M$ , where  $M$  is an integer greater than 1, and each of said narrow bands constitutes an information channel.

7. (original) The node of claim 6 where said narrow bands are composed of essentially a single wavelength, where wavelength  $\lambda_j$  is different from  $\lambda_k$  for all  $j \neq k$ .

8. (original) The node of claim 5 where at least one of said transmitters,  $T_k$ , includes an optical multiplexer that combines optical signals, each of said signals constituting one channel of communication, to form an optical signal of band  $\omega_k$ .

9. (original) The node of claim 8 where said multiplexer is a multi-level multiplexer.

10. (original) The node of claim 1 wherein a collection of elements that includes element  $E_i$ , element  $F_i$ , transmitter  $T_i$ , and receiver  $R_i$  are housed in a single equipment module  $M_i$ , resulting in said node comprising a plurality of modules  $M_i$ ,  $i=1, 2, \dots N$  that are serially connected.

11. (original) The node of claim 1 wherein a collection of elements that includes element  $E_i$ , element  $F_i$ , transmitter  $T_i$  and receiver  $R_i$  are housed in a single equipment module  $M_i$ , resulting in said node comprising a serially interconnected set of modules  $M_i$ ,  $i=1, 2, \dots N$ , with said interconnected set having

- an add-in node input port that is connected to module  $M_1$ ,
- a drop-out node output port that is connected to module  $M_1$ ,
- an add-in node output port that is connected to module  $M_N$ , and
- a drop-out node input port that is connected to module  $M_N$ .

12. (original) The node of claim 11 where said add-in node input port, and said drop-out node output port are in close physical proximity to each other, and said add-in node output port, and said drop-out node input port are in close physical proximity to each other.

13. (original) The node of claim 1 where  
said elements  $E_i$  and  $F_i$ ,  $i=1, 2, \dots N$ , are housed in a single equipment module that includes ports  $P_i$ ,  $i=1, 2, \dots N$ , with each  $P_k$  being coupled to elements  $E_k$  and  $F_k$ ; and  
transmitter  $T_i$  and receiver  $R_i$  form a conversion module  $C_i$  that is outside said single equipment module, thereby resulting in a plurality of conversion modules  $C_i$ ,  $i=1, 2, \dots N$ , with each conversion module  $C_k$  being coupled to port  $P_k$ , for all values of  $k=1, 2, \dots N$ .

14. (original) The node of claim 1 where

each element  $E_i$  has an input port and an output port, each element  $E_i$  has its output port connected to input port of element  $E_{i+1}$ , the input port of element  $E_1$  forms an add-in node input port, and the input port of element  $E_N$  forms an add-in node output port, and

each element  $F_i$  has an input port and an output port, each element  $F_i$  has its output port connected to input port of element  $F_{i-1}$ , the input port of element  $F_N$  forms a drop-out node input port, and the input port of element  $F_1$  forms a drop-out node output port.

15. (currently amended) The node of claim 1, located in a first communication place, further comprising:

a second node, in a second communication place that is remote from said first communication place, comprising

a series connection of elements  $E'_k$ ,  $k=1,2,\dots,N'$ , where  $N'$  is greater than 1, forming a first optical path within said second node, where each of said elements  $E'_k$  injects an optical signal of band  $\omega_k$ , and where  $\omega_k$  is disjoint from  $\omega_m$  for all  $k \neq m$ ;

a series connection of elements  $F'_k$ ,  $k=1,2,\dots,N'$ , forming a second optical path within said second node, where each of said elements  $F'_k$  extracts an optical signal of band  $\omega_k$ ;

a plurality of transmitters  $T'_k$ ,  $k=1,2,\dots,N$ , coupled to said elements  $E'_k$  on a one to one basis; and

a plurality of a receivers  $R'_k$ ,  $k=1,2,\dots,N$ , coupled to said elements  $F'_k$  on a one to one basis; and

a bi-directional optical path that interconnects said node in said first communication place with said second node in said second communication place.

16. (currently amended) The node of claim 15 where  $N=N'$  and each bandwidth  $\omega_k$  in said node in said second communication place corresponds, and is substantially identical, to one bandwidth  $\omega_k$  in said first communication place.

17. (currently amended) The node of claim 15 further including a third node, in a third communication place that is remote from both said first communication place and said second communication place, said third node comprising:

a series connection of elements  $E''_n$ ,  $n=1,2,\dots,N''$ , where  $N''$  is greater than 1, forming a first optical path in said third node, where each of said elements  $E''_n$  injects an optical signal of band  $\omega_n$ , and where  $\omega_n$  is disjoint from  $\omega_0$  for all  $n \neq 0$ ;

a series connection of elements  $F''_n$ ,  $n=1,2,\dots,N'$ , forming a first optical path, where each of said elements  $F''_n$  extracts an optical signal of band  $\omega_n$ ;

a plurality of transmitters  $T''_n$ ,  $n=1, 2, \dots, N'$ , coupled to said elements  $E''_n$  on a one to one basis; and

a plurality of receivers  $R''_n$ ,  $n=1, 2, \dots, N'$ , coupled to said elements  $F''_n$  on a one to one basis; and

a bi-directional optical path that interconnects said second node in said second communication place with said third node in said third communication place.

18. (original) The node of claim 17 where at least one band in said node in said first communication place,  $\omega_i$ , has no matching band  $\omega_k$  in said second communication place.

19. (original) The node of claim 17 where at least one band in said node in said first communication place,  $\omega_i$ , has a matching band  $\omega_k$  in said second communication place.

20. (currently amended) The node of claim 15 further including a third communication place that is remote from both said first communication place and said second communication place, said third communication place comprising:

a third node serially connected to a fourth node, where said third node comprises

a series connection of elements  $E''_n$ ,  $n=1,2,\dots,N''$ , where  $N''$  is greater than 1, forming a first optical path in said third node, where each of said elements  $E''_n$  injects an optical signal of band  $\omega_n$ , and where  $\omega_n$  is disjoint from  $\omega_o$  for all  $n \neq 0$ ;

a series connection of elements  $F''_n$ ,  $n=1,2,\dots,N''$ , forming a first optical path, where each of said elements  $F''_n$  extracts an optical signal of band  $\omega_n$ ;

a plurality of transmitters  $T''_n$ ,  $n=1, 2, \dots, N'$ , coupled to said elements  $E''_n$  on a one to one basis; and

a plurality of receivers  $R''_n$ ,  $n=1, 2, \dots, N'$ , coupled to said elements  $F''_n$  on a one to one basis; and

said fourth node comprises

a series connection of elements  $E'''_p$ ,  $p=1, 2, \dots, N''$ , where  $N''$  is greater than 1, forming a first optical path in said third node, where each of said elements  $E'''_p$  injects an optical signal of band  $\omega_p$ , and where  $\omega_p$  is disjoint from  $\omega_q$  for all  $p \neq q$ ;

a series connection of elements  $F'''_p$ ,  $p=1, 2, \dots, N''$ , forming a first optical path, where each of said elements  $F'''_p$  extracts an optical signal of band  $\omega_p$ ;

a plurality of transmitters  $T'''_p$ ,  $p=1, 2, \dots, N''$ , coupled to said elements  $E'''_p$  on a one to one basis; and

a plurality of receivers  $R'''_p$ ,  $p=1, 2, \dots, N''$ , coupled to said elements  $F'''_p$  on a one to one basis.

**21. (original)** The node of claim 20 where at least one of said bands  $\omega_i$  is equal to one of said bands  $\omega_n$ .

**22. (original)** The node of claim 20 where at least one of said bands  $\omega_i$  is equal to one of said bands  $\omega_n$  and also to one of said bands  $\omega_p$ .

**23. (original)** An arrangement comprising:

a first node as defined in claim 1, in a first location,

a second node as defined in claim 1, in a second location that is remote from said first location; and

a bi-directional optical connection between said first node and said second node.

24. (original) The arrangement of claim 23 where said optical connection comprises an optical path from said add-in node output port of said first node to said drop-out node input port of said second node, and an optical path from said add-in node output port of said second node to said drop-out node input port of said first node.

25. (original) A node comprising:

a first series connection of N elements, where N is greater than 1, forming a first optical path, where each of the elements in said first series injects an optical signal of a preselected band of wavelengths, and where bands of wavelengths of the different elements in said first series are disjoint from each other;

a second series connection of N elements, forming a second optical path that is disjoint from said first optical path, where each of the elements in said second series extracts an optical signal of a preselected band of wavelengths, and where bands of wavelengths of the different elements in said second series are the same as the bands of wavelengths of the different elements in said first series;

a plurality of transmitter elements, with each one of said transmitter elements being coupled to a different one of said N elements in said first series connection of N elements; and



a plurality of receiver elements , with each one of said receiver elements being coupled to a different one of said N elements in said second series connection of N elements.

**26. (currently amended)** An arrangement comprising:

A first module that includes

- a) an add-in port that leads to a set of elements that add an optical signal of a first wavelength,
- b) an add-out port that outputs an optical signal from said set of elements that add an optical signal,
- c) a drop-in port that leads to a set of elements that extract an optical signal of said first wavelength, and
- d) a drop-out port that outputs an optical signal from said set of elements that extract an optical signal;

A second module that includes

- a) an add-in port that leads to a set of elements that add an optical signal of a second wavelength,
- b) an add-out port that outputs an optical signal from said set of elements that add an optical signal,
- c) a drop-in port that leads to a set of elements that extract an optical signal of said second wavelength, and
- d) a drop-out port that outputs an optical signal from said set of elements that extract an optical signal; and

connection elements that optically connect the add-out port of said first module to the add-in port of said second module, and the drop-out ~~drop-out~~ port of said second module is optically connected to the drop-in port of said first module.

**27. (currently amended)** The arrangement of claim 26 further comprising:

A third module that includes

- a) an add-in port that leads to a set of elements that add an optical signal of a second wavelength,
- b) an add-out port that outputs an optical signal from said set of elements that add an optical signal,
- c) a drop-in port that leads to a set of elements that extract an optical signal of said second wavelength, and
- d) a drop-out port that outputs an optical signal from said set of elements that extract an optical signal;

A fourth module that includes

- a) an add-in port that leads to a set of elements that add an optical signal of a first wavelength,
- b) an add-out port that outputs an optical signal from said set of elements that add an optical signal,
- c) a drop-in port that leads to a set of elements that extract an optical signal of said first wavelength, and
- d) a drop-out port that outputs an optical signal from said set of elements that extract an optical signal;

connection elements that optically connect the add-out port of said third module to the add-in port of said fourth module, and the drop-out ~~drop-out~~ port of said fourth module is optically connected to the drop-in of said third module; and

connection elements that optically connect the drop-out port of said third module to the add-in port of said fourth module, and the drop-out port of said fourth module is optically connected to the add-in of said third module.

**28. (currently amended)** The arrangement of claim 26 further comprising:

A third module that includes

- a) an add-in port that leads to a set of elements that add an optical signal of a first wavelength,
- b) an add-out port that outputs an optical signal from said set of elements that add an optical signal,
- c) a drop-in port that leads to a set of elements that extract an optical signal of said first wavelength, and
- d) a drop-out port that outputs an optical signal from said set of elements that extract an optical signal;

A fourth module that includes

- a) an add-in port that leads to a set of elements that add an optical signal of a second wavelength,
- b) an add-out port that outputs an optical signal from said set of elements that add an optical signal,

- c) a drop-in port that leads to a set of elements that extract an optical signal of said second wavelength, and
- d) a drop-out port that outputs an optical signal from said set of elements that extract an optical signal;

connection elements that optically connect the add-out port of said third module to the add-in port of said fourth module, and the drop-out ~~drop-out~~ port of said fourth module is optically connected to the drop-in of said third module; and

connection elements that optically connect the drop-out port of said third module to the add-in port of said fourth module, and the drop-out port of said fourth module is optically connected to the add-in of said third module.

**29. (currently amended)** A node comprising:

a first sub-node serially connected to a second sub-node, where said first sub-node comprises

a series connection of elements  $E''_n$ ,  $n = 1, 2, \dots, N''$ , where  $N''$  is greater than 1, forming a first optical path in said first ~~third~~ node, where each of said elements  $E''_n$  injects an optical signal of band  $\omega_n$ , and where  $\omega_n$  is disjoint from  $\omega_0$  for all  $n \neq 0$ ;

a series connection of elements  $F''_n$ ,  $n = 1, 2, \dots, N''$ , forming a first optical path, where each of said elements  $F''_n$  extracts an optical signal of band  $\omega_n$ ;

a plurality of transmitters  $T''_n$ ,  $n = 1, 2, \dots, N''$ , coupled to said elements  $E''_n$  on a one to one basis; and

a plurality of receivers  $R''_n$ ,  $n = 1, 2, \dots, N''$ , coupled to said elements  $F''_n$  on a one to one basis; and

said ~~second~~ fourth node comprises

a series connection of elements  $E''_p$ ,  $p = 1, 2, \dots, N''$ , where  $N''$  is greater than 1, forming a first optical path in said ~~second~~ third node, where each of said elements  $E''_p$  injects an optical signal of band  $\omega_p$ , and where  $\omega_p$  is disjoint from  $\omega_q$  for all  $p \neq q$ ;

a series connection of elements  $F''_p$ ,  $p = 1, 2, \dots, N''$ , forming a first optical path, where each of said elements  $F''_p$  extracts an optical signal of band  $\omega_p$ ;

a plurality of transmitters  $T''_n$ ,  $n = 1, 2, \dots, N''$ , coupled to said elements  $E''_n$  on a one to one basis; and

a plurality of receivers  $R''_n$ ,  $n = 1, 2, \dots, N''$ , coupled to said elements  $F''_n$  on a one to one basis; and

where at least one of said bands  $\omega_n$  is equal to one of said bands  $\omega_p$ .

30. (currently amended) ~~A~~ An arrangement comprising a plurality of nodes as defined in claim 1, said plurality of nodes interconnected to form a ring.

31. (currently amended) A node comprising:

a first optical path composed of a series connection of elements  $E_i$ ,  $i = 1, 2, \dots, N$ , where  $N$  is greater than 1, where each of said elements  $E_i$  injects an optical signal of band  $\omega_i$ , and where  $\omega_i$  is disjoint from  $\omega_j$  for all  $i \neq j$ , followed by a series connection of elements  $F_j$ ,  $j = 1, 2, \dots, M$ , where each of said elements  $F_j$  extracts an optical signal of band  $\omega_j$ , and where at least one  $\omega_i$  is equal to a  $\omega_j$ ; and

a second optical path, disjoint from said first optical path, composed of a series connection of elements  $F_i$ ,  $i=1,2,\dots,N$ , followed by series connection of elements  $E_j$ ,  $j=1,2,\dots,M$ .

a plurality of transmitters  $T_i$ ,  $i=1, 2, \dots,N$ , coupled to said elements  $E_i$  on a one to one basis;

a plurality of transmitters  $T_j$ ,  $j=1, 2, \dots,M$ , coupled to said elements  $E_j$  on a one to one basis

a plurality of receivers  $R_i$ ,  $i=1, 2, \dots,N$ , coupled to said elements  $F_i$  on a one to one basis; and

a plurality of receivers  $R_j$ ,  $j=1, 2, \dots,M$ , coupled to said elements  $F_j$  on a one to one basis; ~~and~~.

32. (new) A node, comprising:

a) a first module having an add-in port that leads to a set of elements that add an optical signal of a first wavelength, an add-out port that outputs an optical signal from said set of elements that add an optical signal, a drop-in port that leads to a set of elements that extract an optical signal of said first wavelength, and a drop-out port that outputs an optical signal from said set of elements that extract an optical signal;

b) said add-out port is physically disposed directly adjacent said drop-in port such that no other port is positioned between said add-out port and said drop-in port;

c) said add-in port is physically disposed directly adjacent said drop-out port such that no other port is positioned between said add-in port and said drop-out port.

33. (new) A node as set forth in Claim 32, further including:

a) second module having an add-in port that leads to a set of elements that add an optical signal of a second wavelength, an add-out port that outputs an optical signal from said set of elements that add an optical signal, a drop-in port that leads to a set of elements that extract an optical signal of said second wavelength, and a drop-out port that outputs an optical signal from said set of elements that extract an optical signal;

b) said add-out port is physically disposed directly adjacent said drop-in port such that no other port is positioned between said add-out port and said drop-in port; and,

c) connection elements that optically connect the add-out port of said first module to the add-in port of said second module, and the drop-out port of said second module is optically connected to the drop-in port of said first module.

34. (new) A node as set forth in Claim 33, wherein:

a) each of said first and second modules include first and second ends, said add-in port, said add-out port, said drop-in port and said drop-out port of each of said first and second modules are physically disposed adjacent the corresponding first end of said first and second modules and removed from the corresponding second end of said first and second modules.

35. (new) A node as set forth in Claim 34, wherein:

a) said add-out ports of said first and second modules are physically spaced less than two inches from the corresponding drop-in ports of said first and second modules; and,

b) said add-in ports of said first and second modules are physically spaced less than two inches from the corresponding drop-out ports of said first and second modules.